Verifying the Performance of a Coupled Fire-Atmosphere Model

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NCAR

COLORADO
Center of Excellence for Advanced Technology Aerial Firefighting
Department of Public Safety

Colorado Fire Prediction System (CO-FPS)

Rep Tracy Kraft-Tharp | Dr. Jim Hurrell NCAR Director | Bill Mahoney NCAR/RAL | Gov. Hickenlooper | Dr.Janice Coen NCAR/MMM

Signed May 20, 2015

An Act

HOUSE BILL 15-1129

BY REPRESENTATIVE(S) Kraft-Tharp, Duran, Garnett, Ginal, Hamner, Kagan, Mitsch Bush, Pettersen, Rosenthal, Ryden, Salazar, Singer, Vigil, Williams, Winter, Hullinghorst, Lontine, Pabon;
also SENATOR(S) Roberts, Grantham, Heath, Aguilar, Carroll, Donovan, Hodge, Jones, Kefalas, Kerr, Merrifield, Newell, Todd.

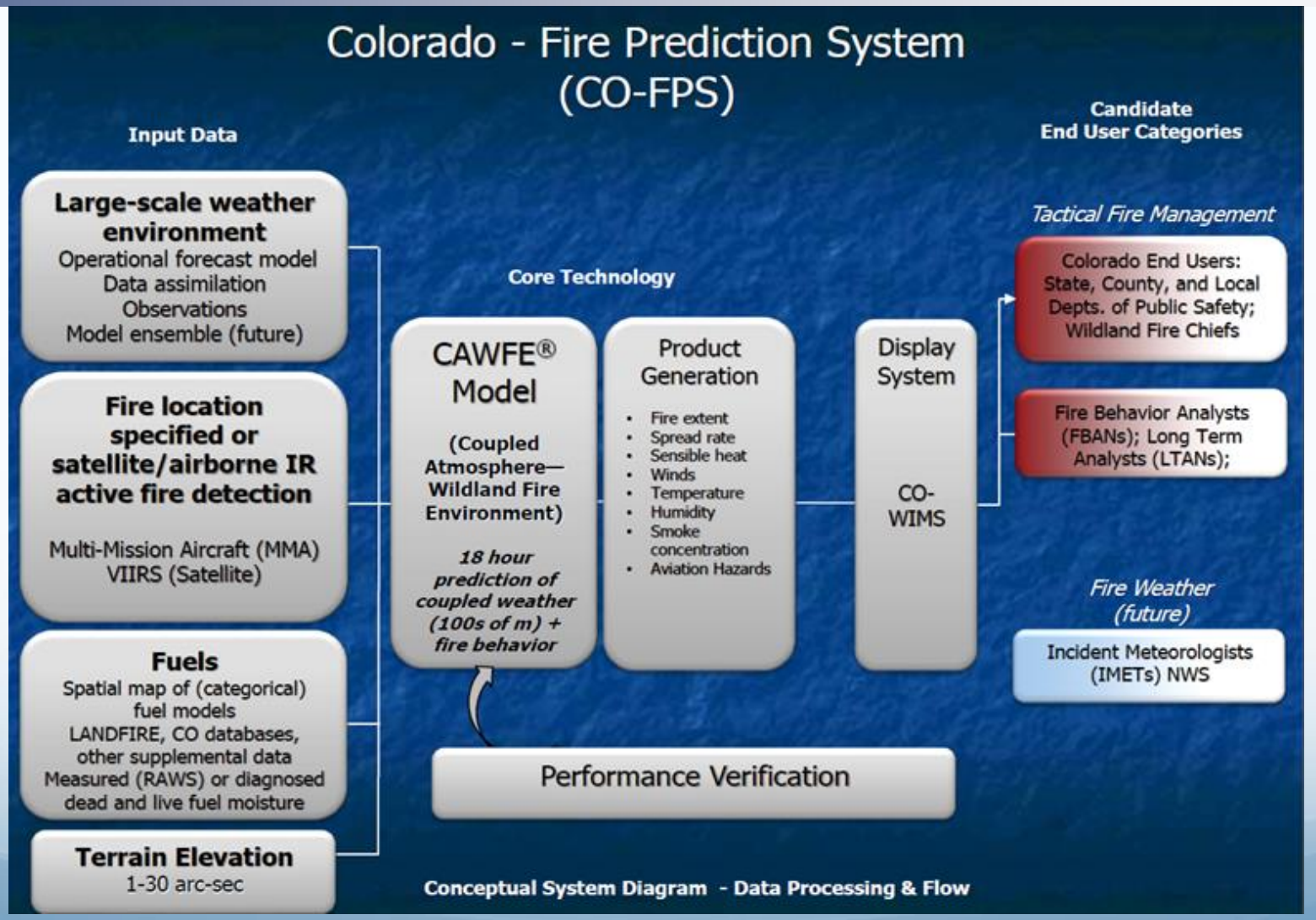
CONCERNING DISASTER PREDICTION AND DECISION SUPPORT SYSTEMS BY THE DEPARTMENT OF PUBLIC SAFETY, AND, IN CONNECTION THEREWITH, MAKING AN APPROPRIATION.

Be it enacted by the General Assembly of the State of Colorado:

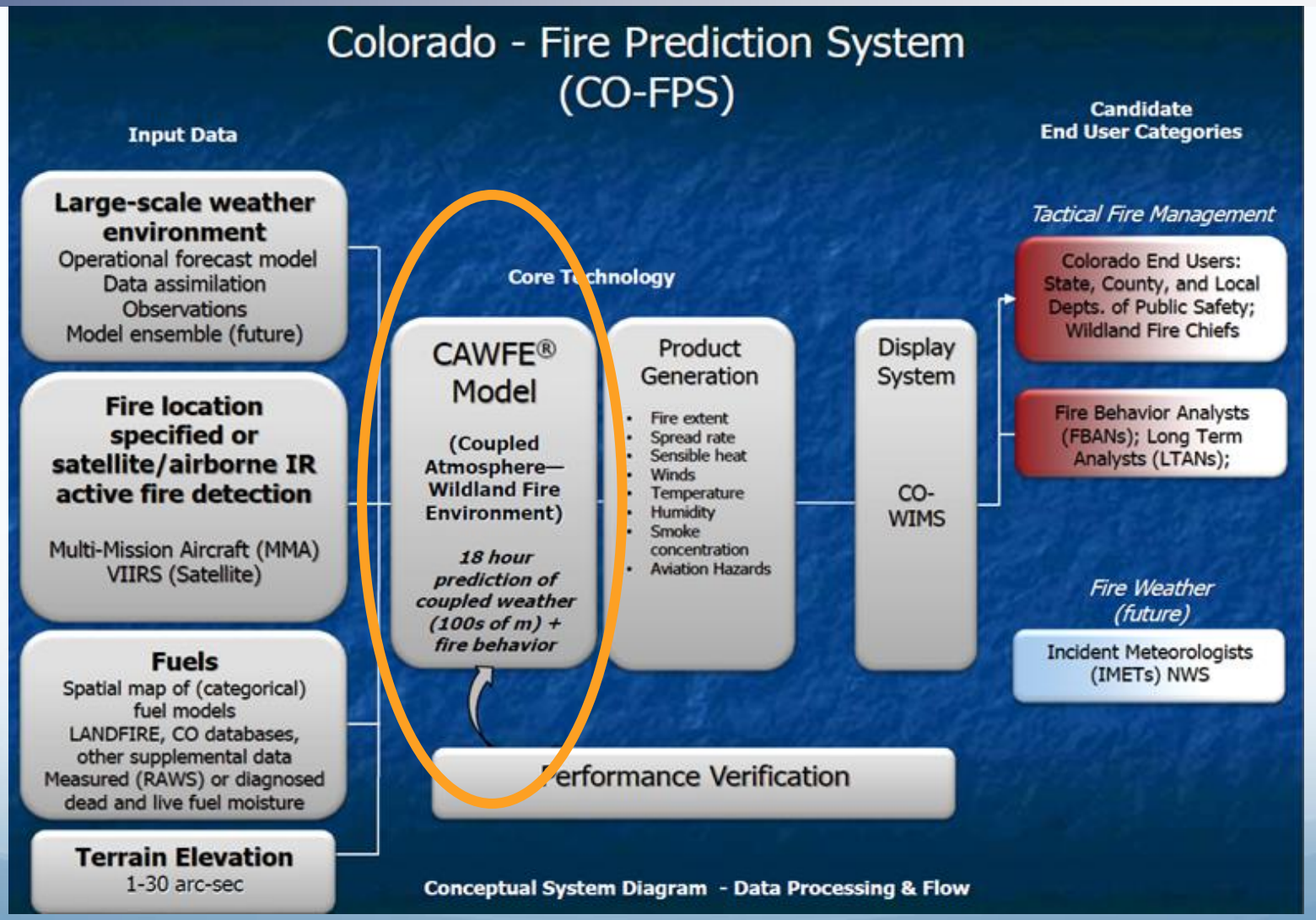
SECTION 1. Legislative declaration. (1) The general assembly hereby finds and declares that:

(a) Wildland fires are exceedingly complex phenomena. Despite rigorous training, abundant resources, and weather forecasts, even seasoned responders may be tragically unprepared for complex, unpredictable, and dramatic fire behavior. Human intelligence cannot integrate all the interacting factors to anticipate when weather and other factors will combine with topography to dramatically amplify fire behavior.

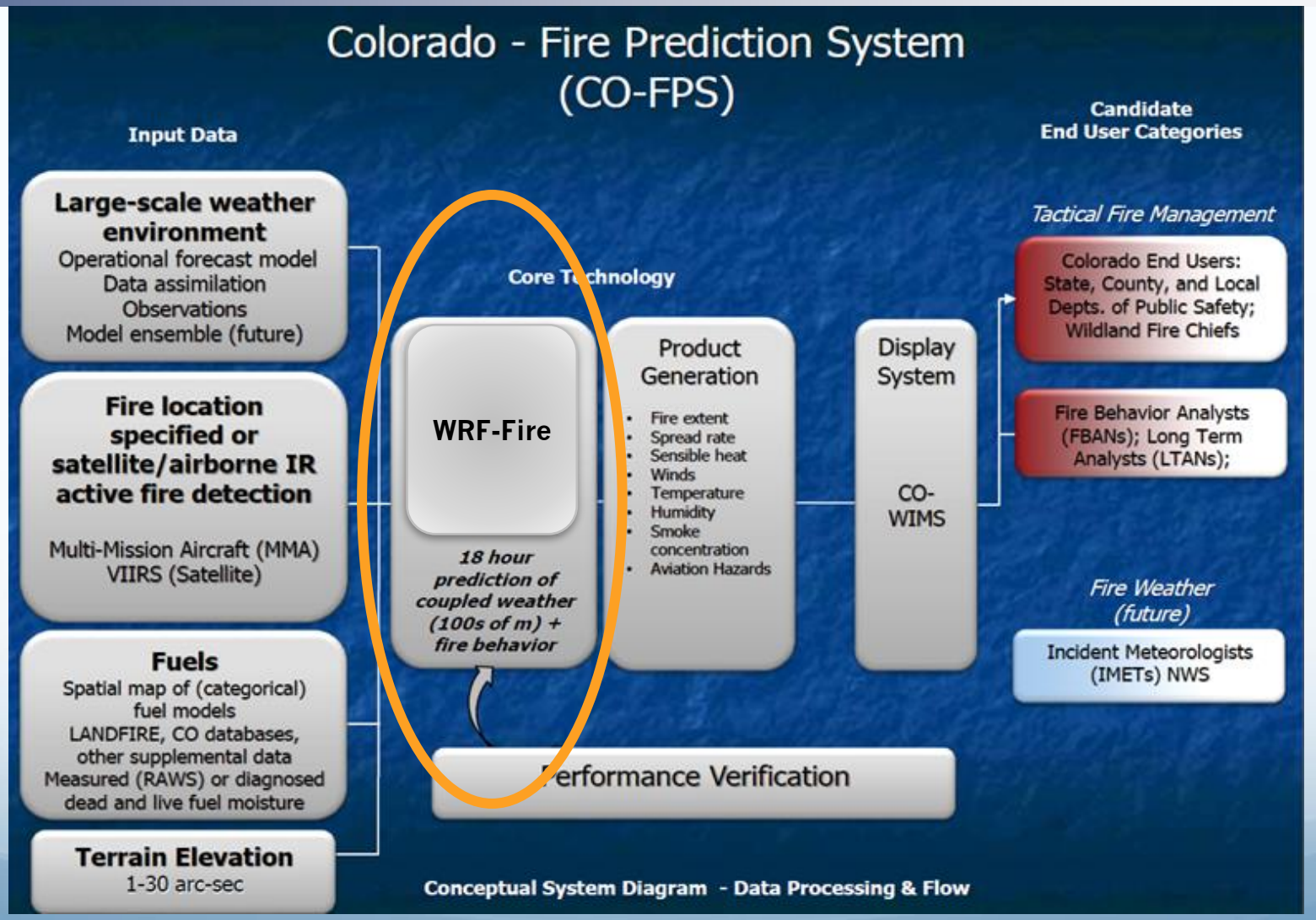
CO-FPS Framework



CO-FPS Framework

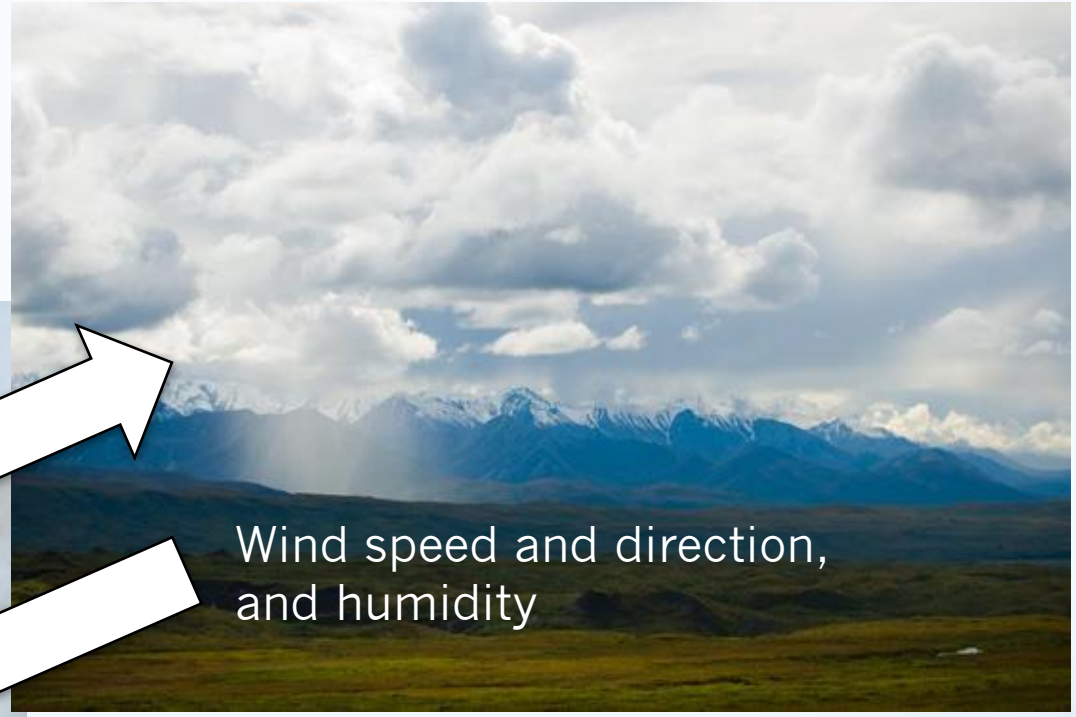


CO-FPS Framework



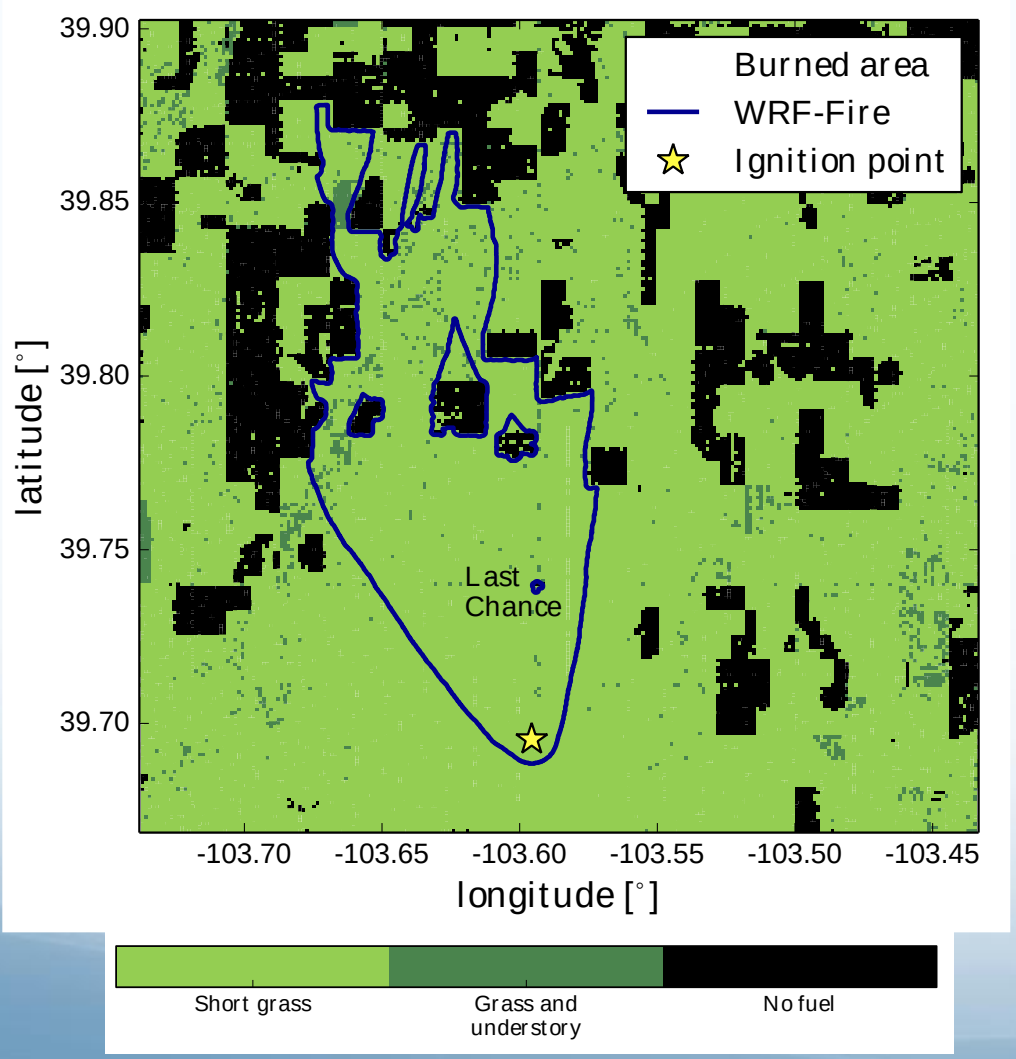
WRF-Fire: A Coupled Model

The wind (i.e. atmosphere) affects the rate of spread and direction of fire as well as fuel moisture (which determines weather and how intensely a fire burns).

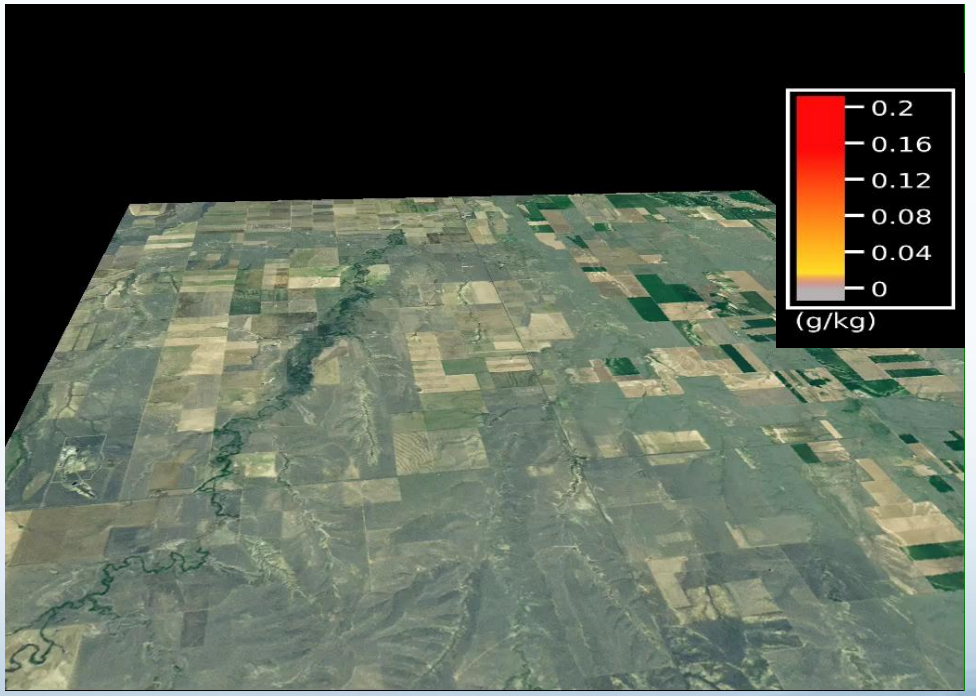


Burning fuel releases heat and water vapor into the atmosphere, causing updrafts and changing the winds

Example Case: Last Change (2012)



Smoke concentration:
0700 – 1900 LT
June 25th 2012



Courtesy Pedro Jimenez

Challenge for Verification

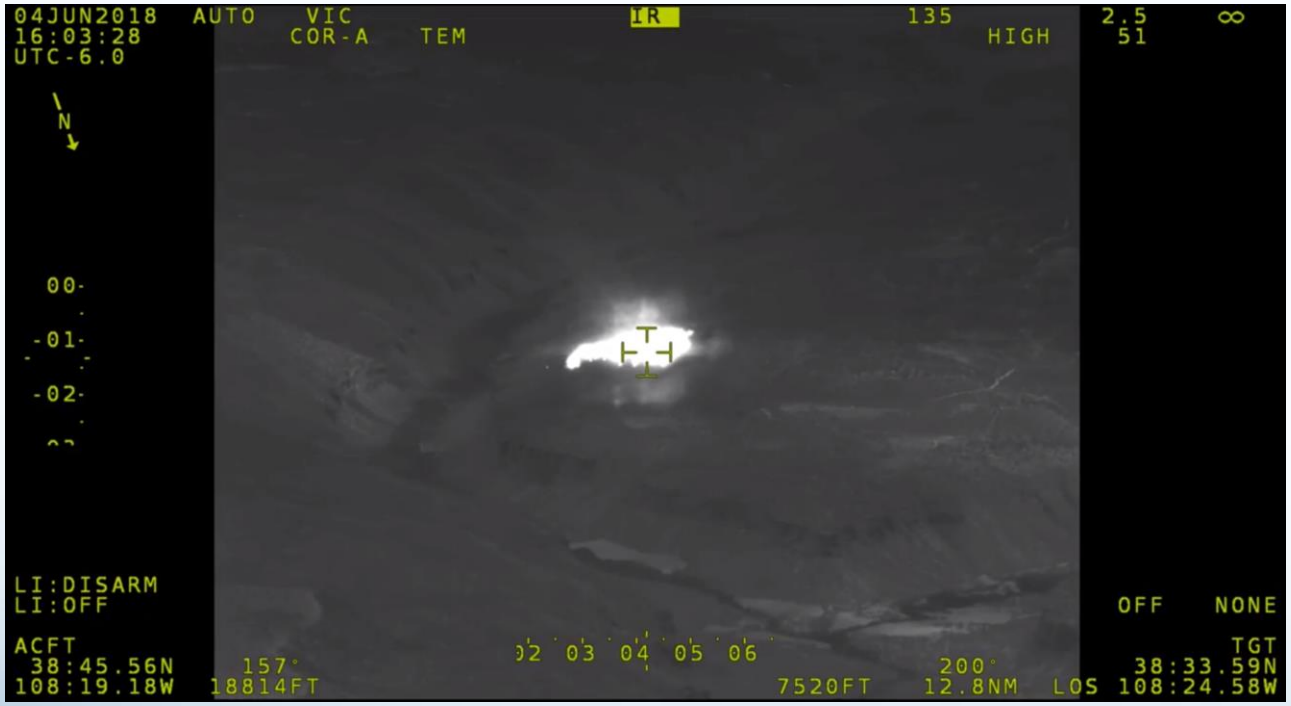
Weather is…

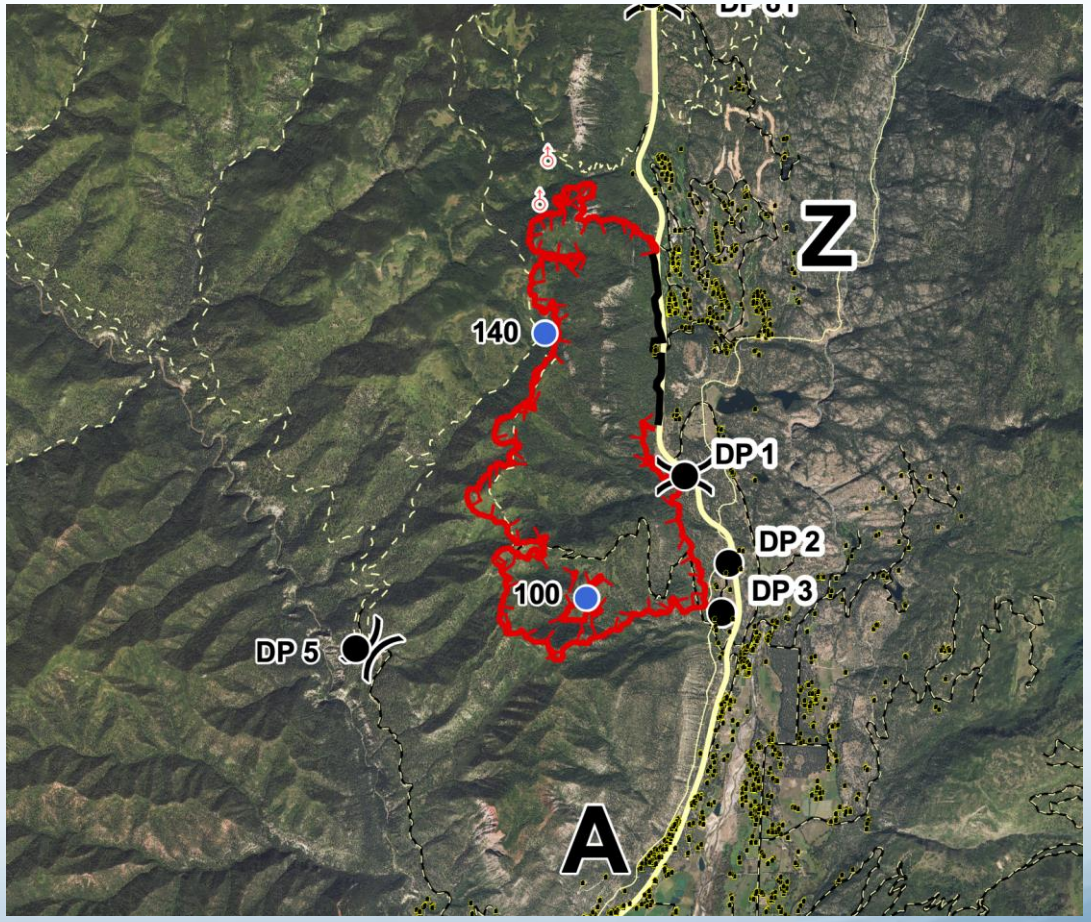
- Modeled worldwide, often on a regular grid
- Always occurring
- Observed regularly and to standards
- Regular repositories of data are available

Wildfire is…

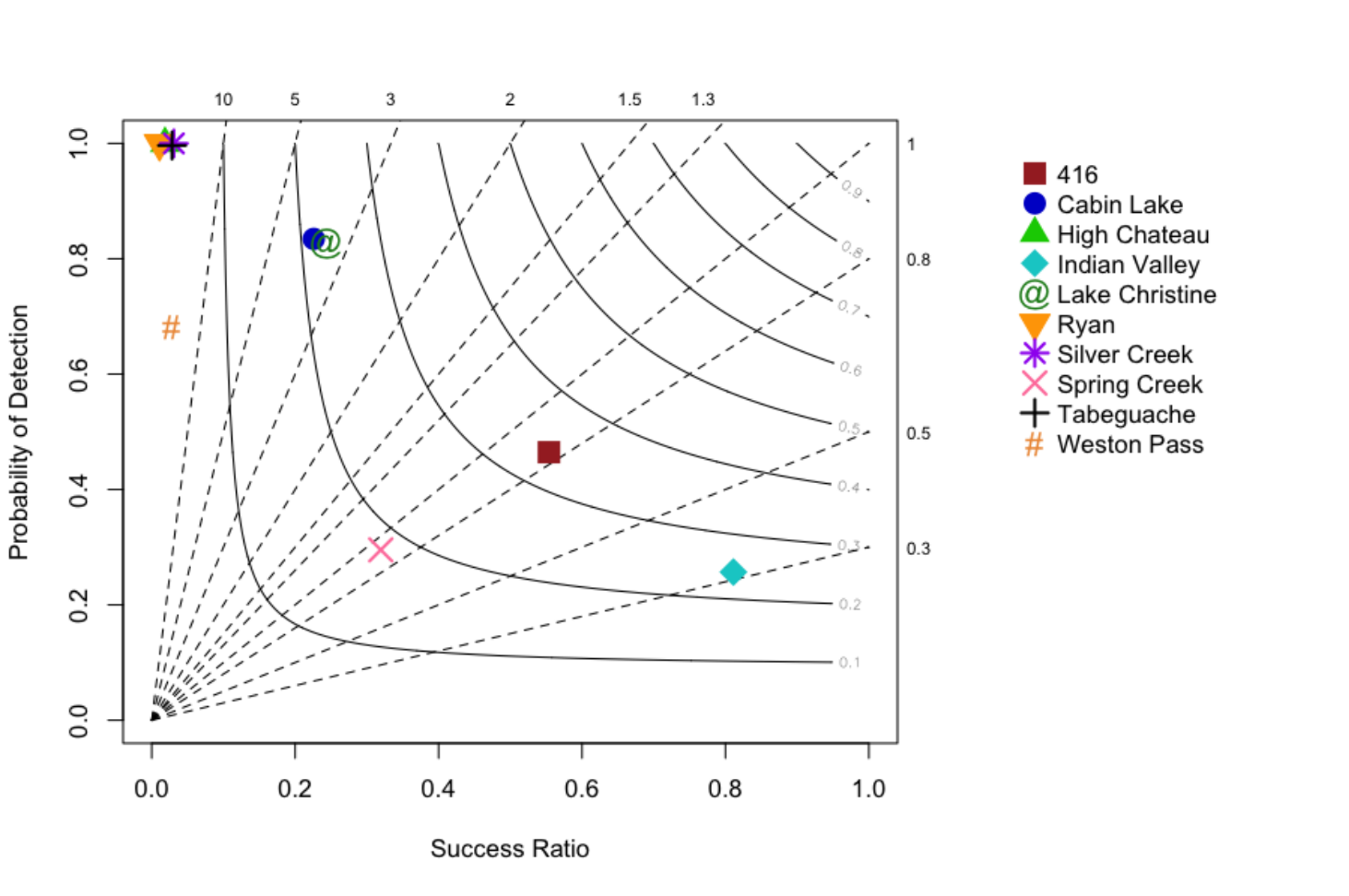
- Modeled only at the location of the fire
- Occurs with little forewarning
- Observed to provide tactical, real time data
- Data are archived and stored in many formats (including file cabinets), or not saved at all

What Data Do We Have?





A Fire Blob Is Like A Precipitation Blob



Verify What Is Important

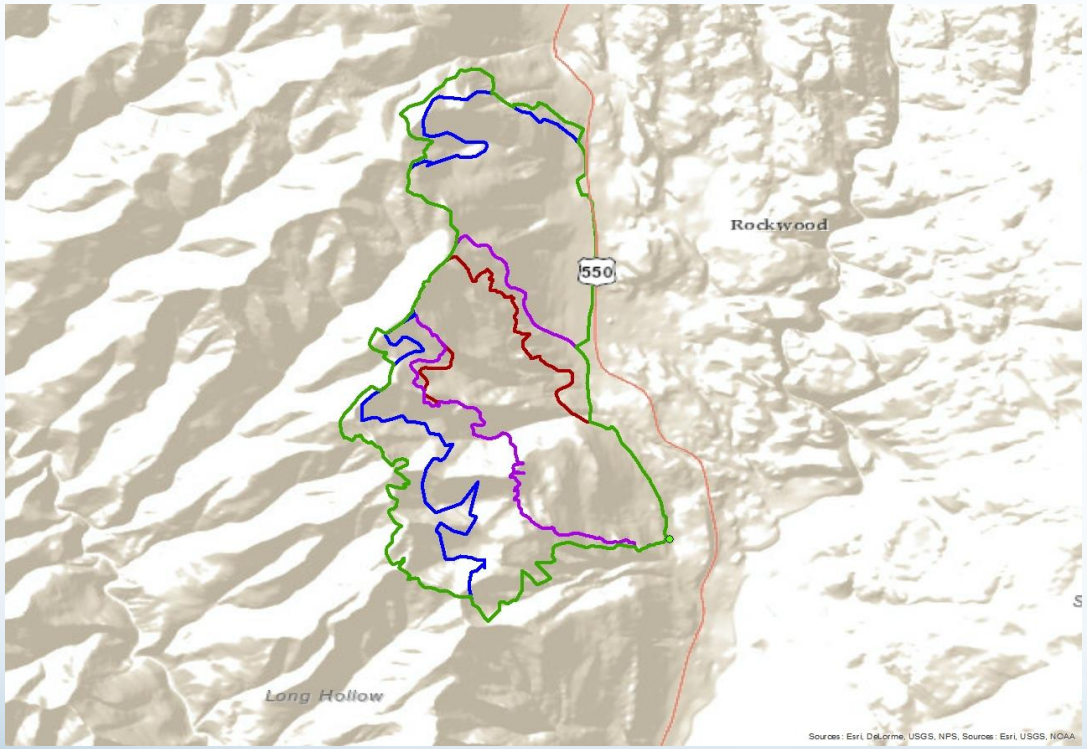
- Regular stakeholder meetings allow presentation of current state of model and assessment of performance
- Stakeholders may also be able to point you to verification data you are not aware of (e.g., file cabinets or command personnel)
- Feedback on most important uses of CO-FPS
- Example: Overprediction of fire spread is not nearly as important to CO personnel as direction of spread

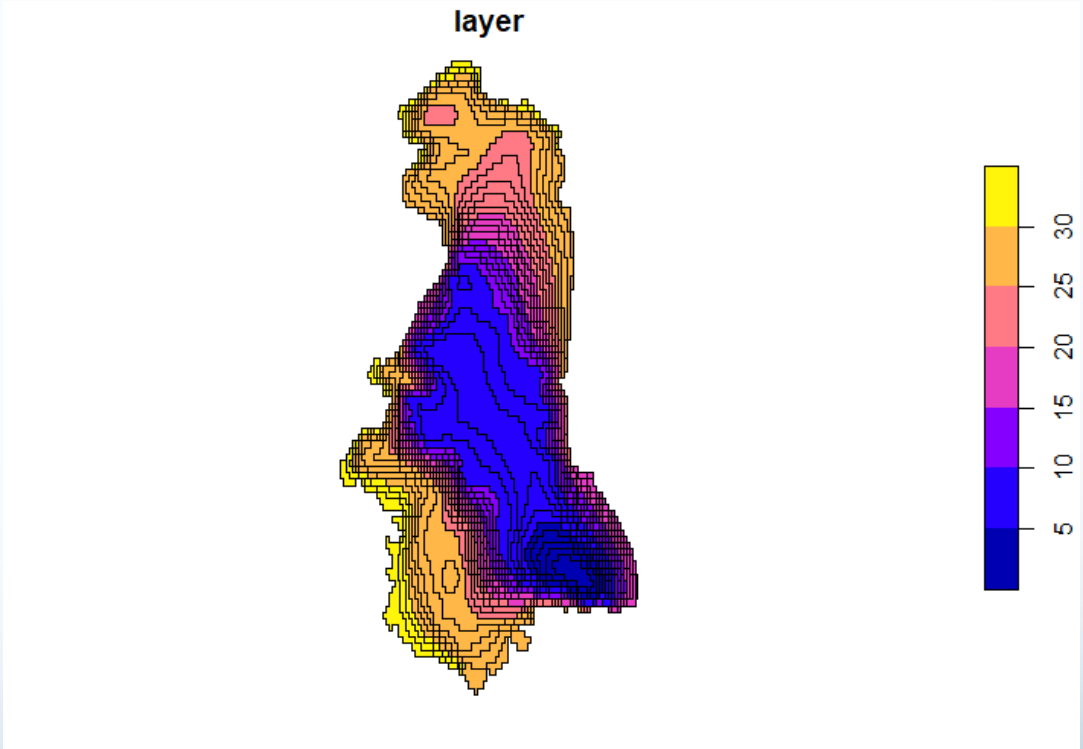
Adapt Current Verification Tools

- Method for Object-based Diagnostics and Evaluation – Time Domain (MODE-TD) allows for both time and space object-based verification of precipitation or other weather prediction
  - Available as part of Model Evaluation Tools (MET) package at (website)
- Fire spreads in a way similar to precipitation
- MODE-TD's direction and speed metrics could give quantitative assessment of whether CO-FPS captures fire spread

Courtesy Randy Bullock and Barbara Brown

Requirement – Hourly Observations





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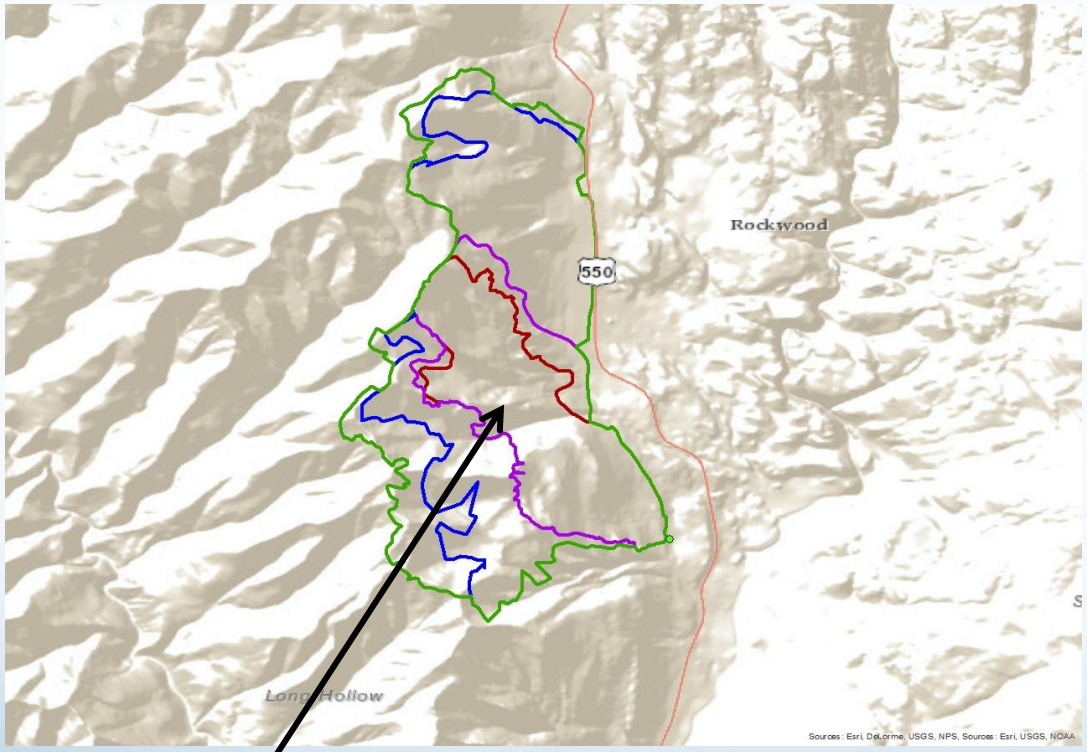

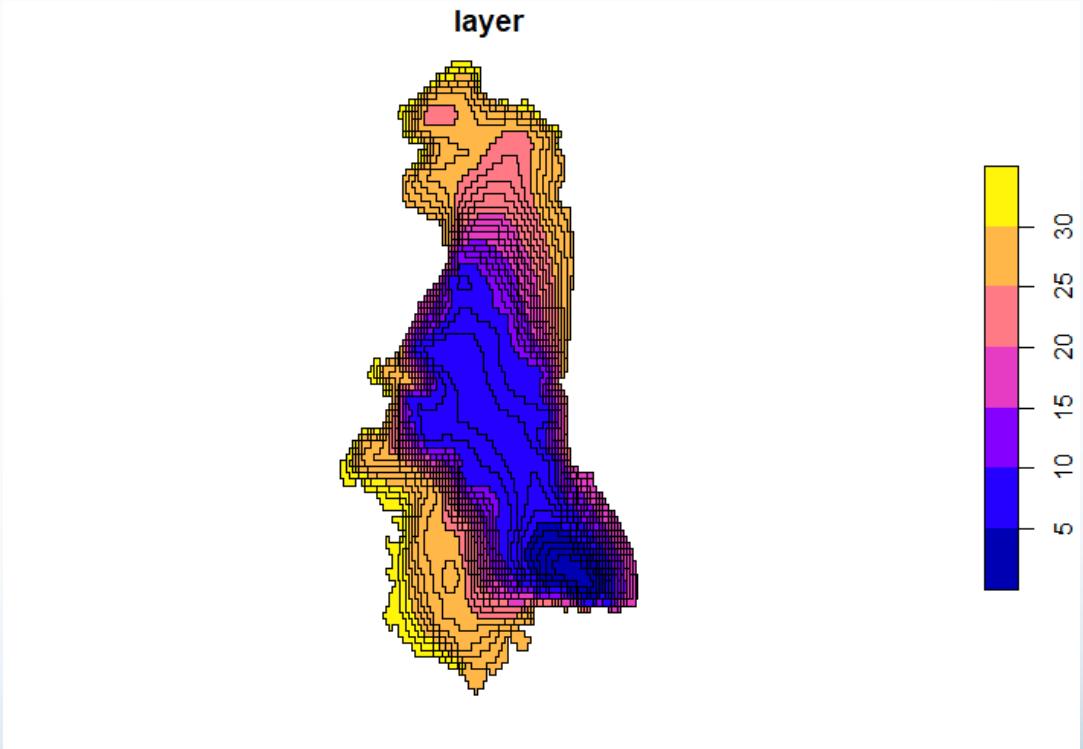

416 fire – 4 perimeters available across 30 hours

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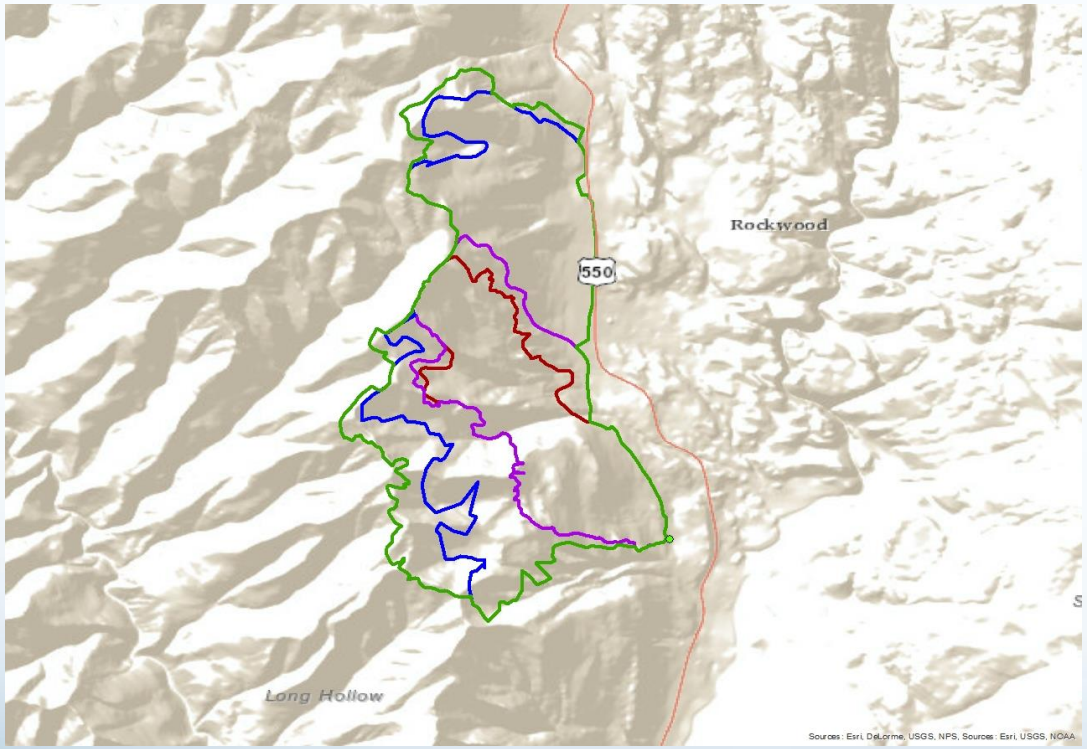
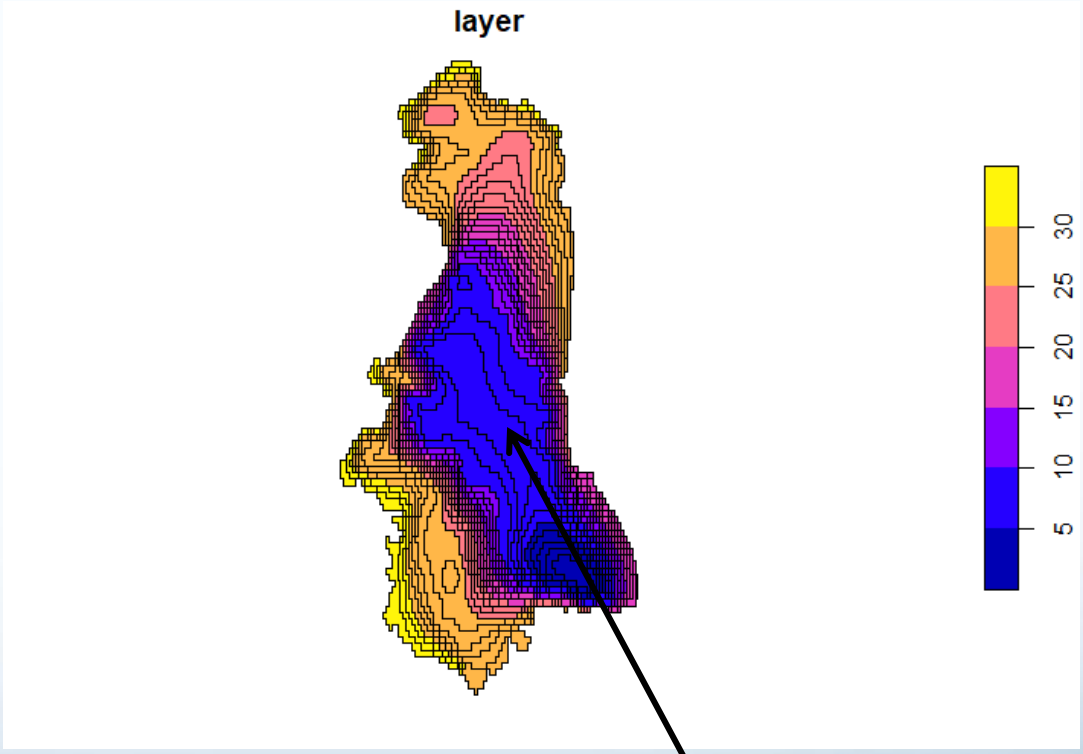
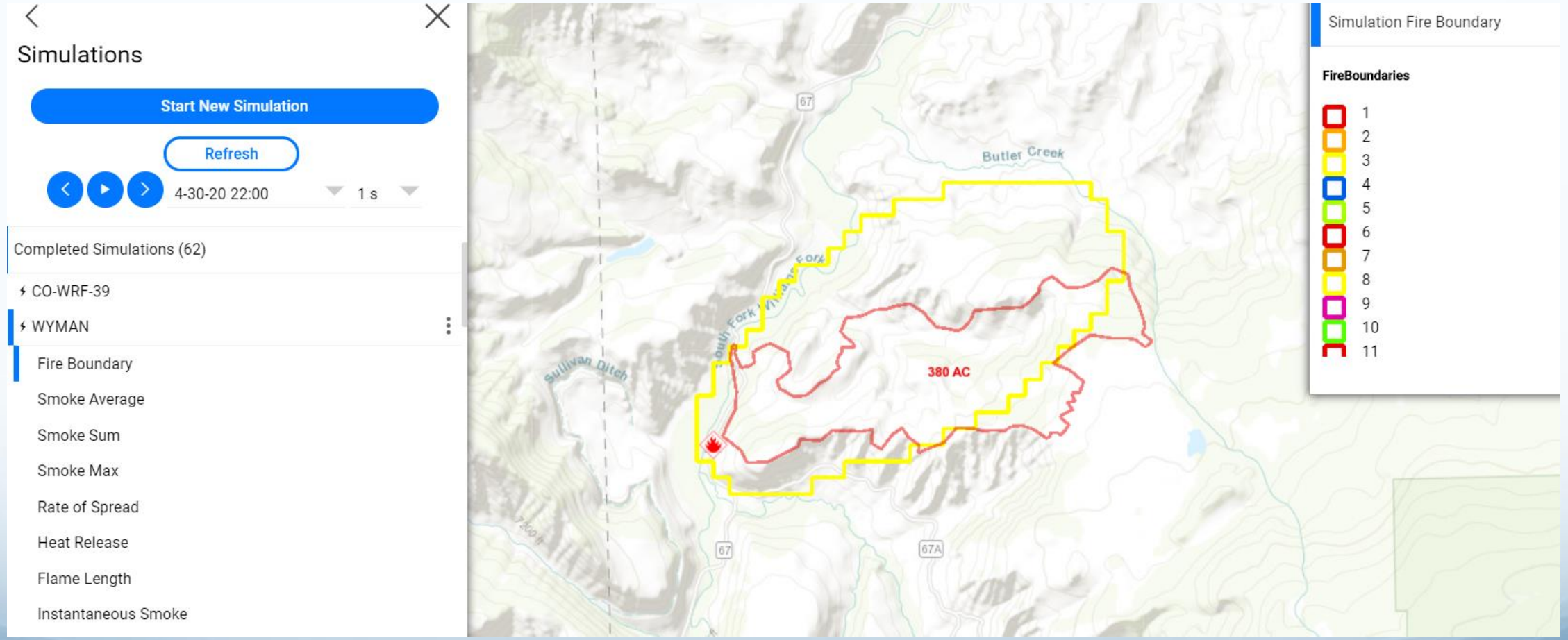




Interpolation produces hourly boundaries to allow finer-scale assessment of direction of spread

Operational Deployment



Resources

- Email: aander@ucar.edu
- CoE: https://www.cofiretech.org/
  - https://www.cofiretech.org/feature-projects/colorado-fire-prediction-system
- NCAR project page: https://ral.ucar.edu/projects/colorado-fire-prediction-system-co-fps